Reservoir Operation Study Computer Program (RESOP)

- Purposes:

  Assist in the planning, design, and evaluation of reservoirs which must meet water supply and demand requirements.

- Results:

  Compute a monthly water balance for a reservoir system based on inflow, outflow and reservoir storage data.

- Advantages:

  Mathematics is relatively simple;

  Multiple reservoirs in series can be analyzed;

  Up to 50 years of reservoir operation can be computed.

Reservoir Operation Study Computer Program (RESOP)

- Inflow to Reservoir:

  Runoff from the watershed;

  Rainfall on the water surface of the reservior;

  Any Outside Pumping, and

  Release from an upstream reservoir.

- Outflow from Reservoir:

  Seepage, evaporation, spill and demand.

- Demands:

  Low flow, irrigation, municipal and other requirements.

Reservoir Operation Study Computer Program (RESOP) - INPUTS

- Control Input:
  1. Reservoir storage - surface area relation measured by USGS
  1. Drainage area - from Topographical map or GIS DEM coverage;
  1. Initial storage - measured or assumed;
  1. Limits:

     Upper limit: the maximum usable or permissible storage;

     Lower limit: the reservoir to be depleted;

Reservoir Operation Study Computer Program (RESOP) - INPUTS - Continued

- General Input:
  1. Evaporation coefficient (Annual) - depending on the type of evaporation data used;
  1. First year of records;
  1. Code - indicate the relation among reservoirs;
  1. Code - indicate the model run type (normal/optimal).
- Seepage - monthly value:
  1. Paired values of surface area and seepage rate estimated.

Reservoir Operation Study Computer Program (RESOP) - INPUTS - Continued

- Rainfall:
  1. Monthly rainfall values taken from Climatological Data National Oceanic and Atmospheric Administration.
- Runoff:
  1. Monthly outflow from watershed to reservoir. Values are from USGS or transferred/adjusted from a nearby gaged watershed.
- Evaporation:
  1. Monthly data from Class A pan, free water surface, or actual lake evaporation.

Reservoir Operation Study Computer Program (RESOP) - INPUTS - Continued

- Demand:
  1. Monthly demand that the reservoir is required to satisfy. The data are from municipal supply, etc.
- Other Inputs:
  1. Other types (pumped water) of inflow (positive value) or outflow (negative value) for the reservoir. Evaporation:

Reservoir Operation Study Computer Program (RESOP) - OUTPUTS

- Contain detailed information on each of the water balance aspects for each reservoir and year of operation.
  1. Total inflow to the reservoir;
  1. Storage in the reservoir at the end of the month;
  1. Deficit (difference between storage and the lower storage limit) at the end of month;
  1. Spill from the reservoir at the end of month;
  1. Optimized Demand computed by program;

Reservoir Operation Study Computer Program (RESOP) - Example

- Green City reservoir (1974) is located in the Green Hills Region in Sullivan County.
- The reservoir is a source of water supply for the community – Green City and Greencastle and Sullivan Country rural water district.
- The drainage area of approximately 871 acres.
- Two weather stations nearby, Milan and Spickard, with long term record for precipitation and evaporation.

Reservoir Operation Study Computer Program (RESOP) - Example - Continued

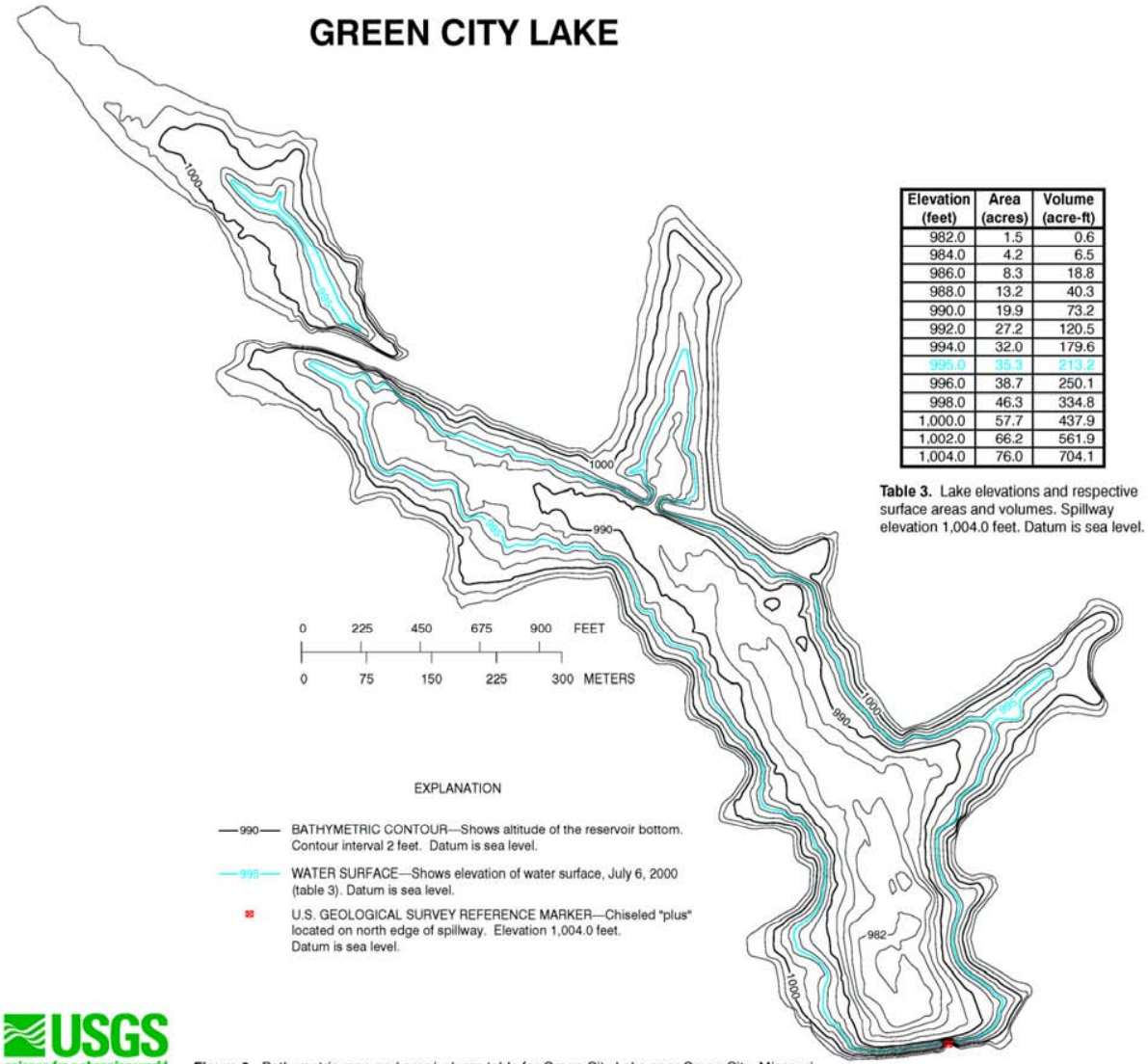
- Study Year Selection
  1. Based upon present stream flow on Locust Creek near Linneus, Locust Creek at Milan

     Current water condition is similar to 1950s.
  1. Historic Palmer drought indices

     Palmer indices had a moderate drought level of about negative two from September 1999 through April 2000;

     NOAA forecasts are for a moderate drought most likely to continue through 2000.
  1. 1952~61 selected to assess the water availability of the reservoir during a multi-year drought.

GREEN CITY LAKE



Elevation (feet)	Area (acres)	Volume (acre-ft)
982.0	1.5	0.6
984.0	4.2	6.5
986.0	8.3	18.8
988.0	13.2	40.3
990.0	19.9	73.2
992.0	27.2	120.5
994.0	32.0	179.6
995.0	35.3	213.2
996.0	38.7	250.1
998.0	46.3	334.8
1,000.0	57.7	437.9
1,002.0	66.2	561.9
1,004.0	76.0	704.1

Table 3. Lake elevations and respective surface areas and volumes. Spillway elevation 1,004.0 feet. Datum is sea level.

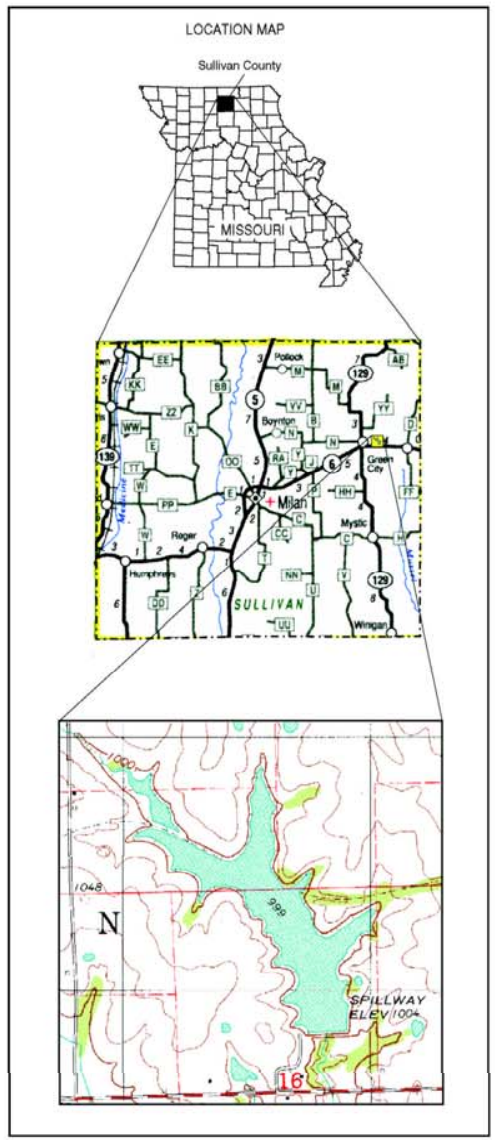


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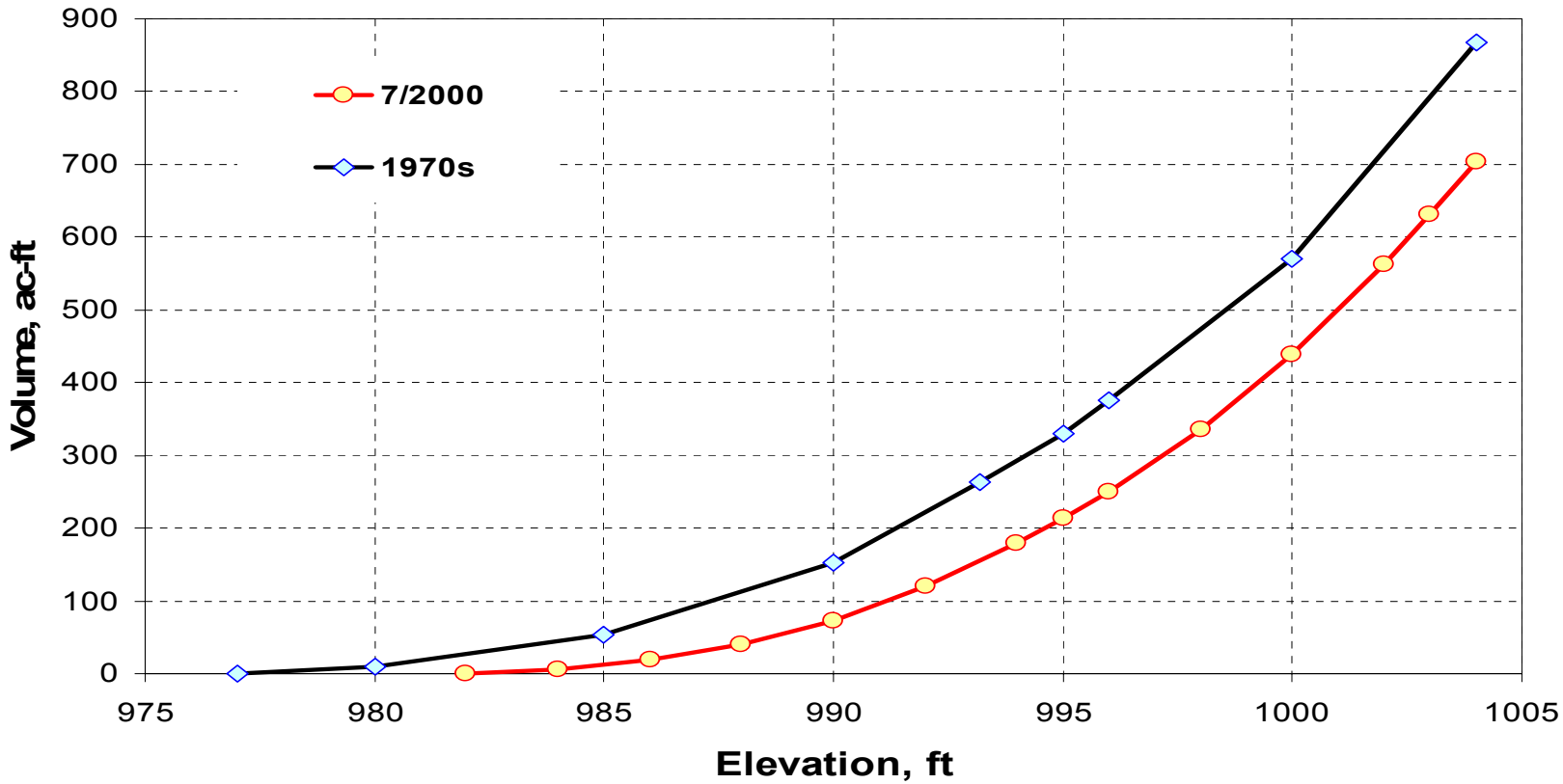
Figure 3. Bathymetric map and area/volume table for Green City Lake near Green City, Missouri.

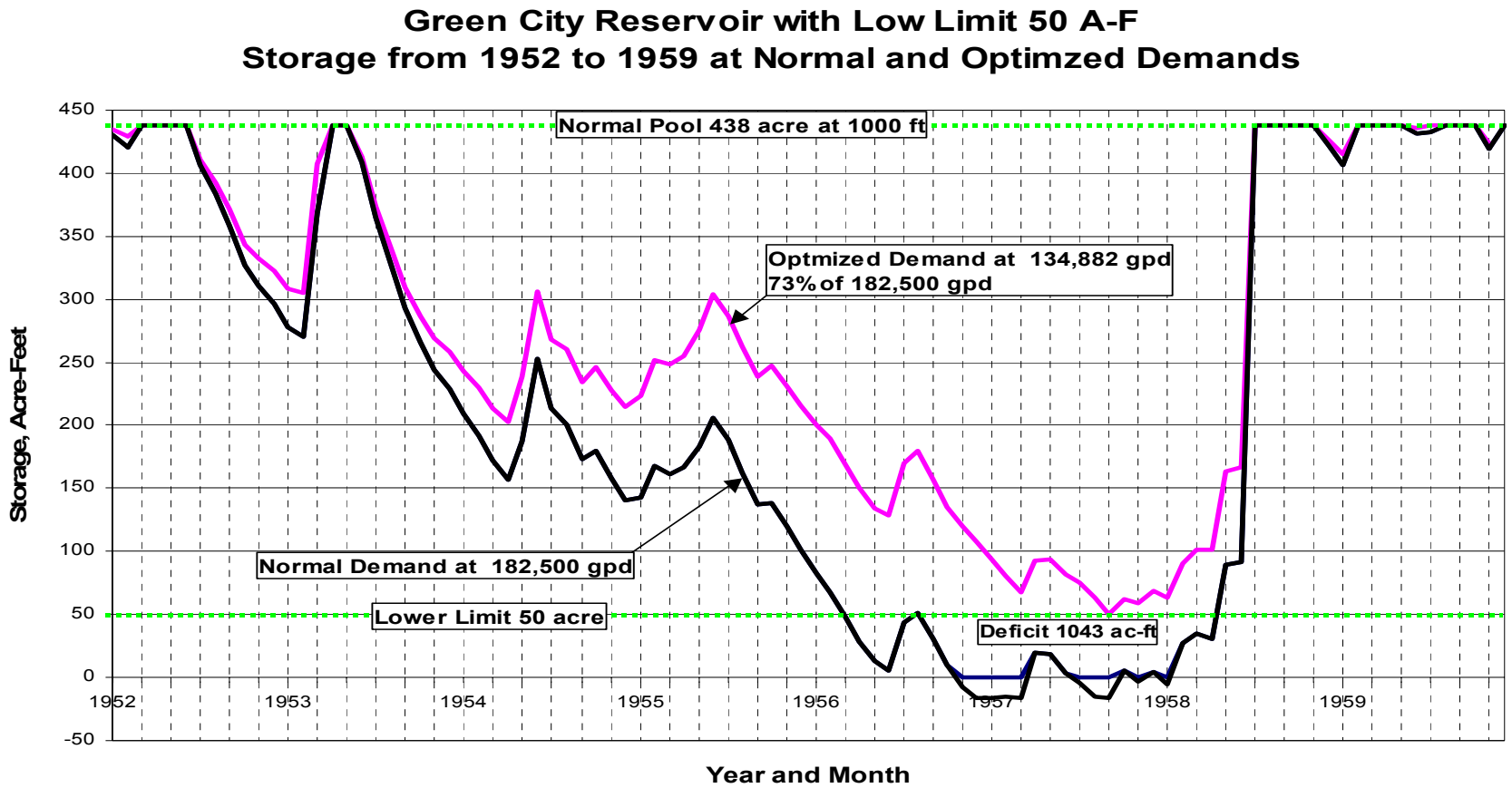
Reservoir Operation Study Computer Program (RESOP) - Example - Continued

- Reservoir storage-surface area surveys (70s and 7/00)



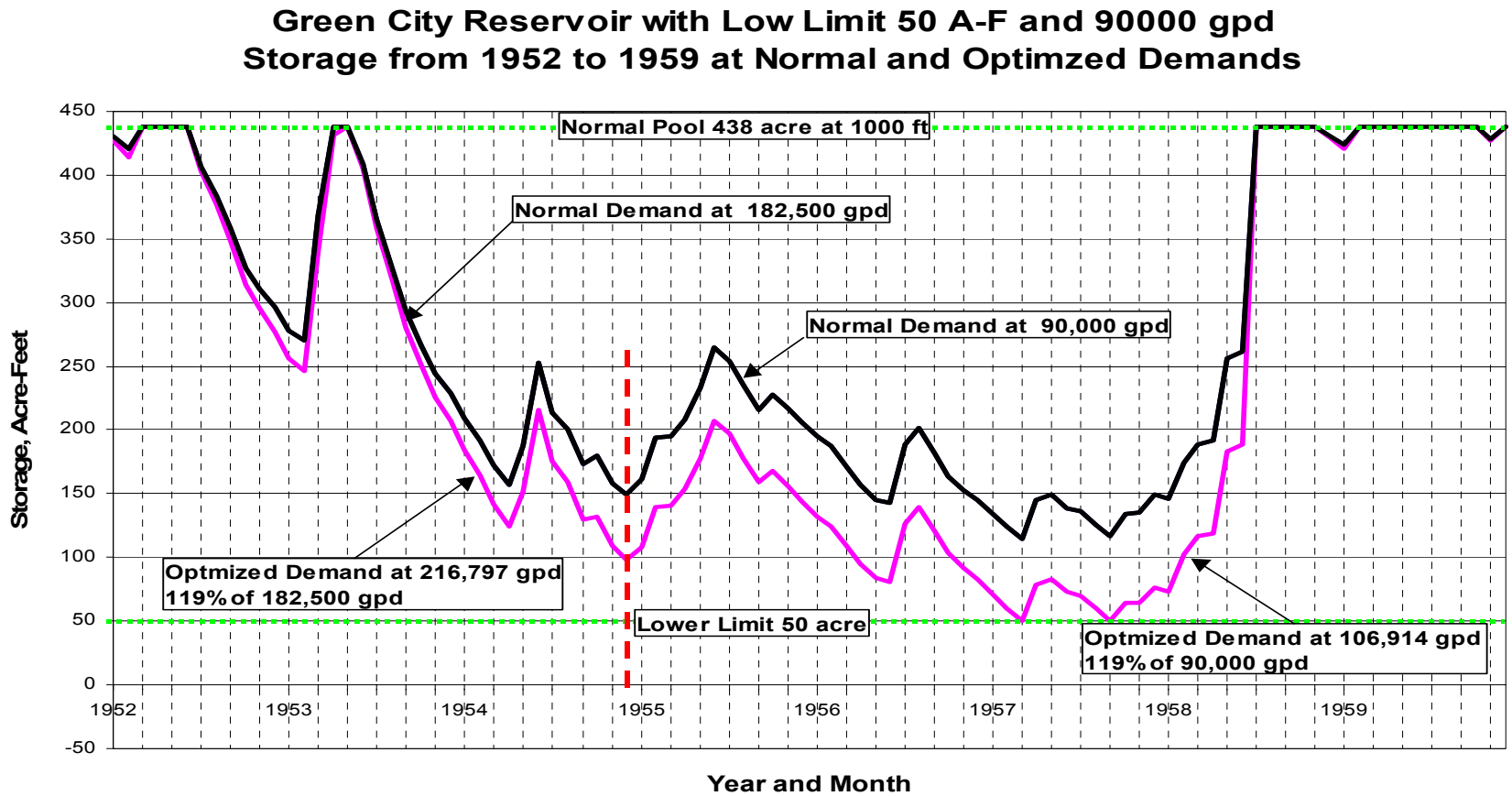
Reservoir Operation Study Computer Program (RESOP) - Example - Continued

- Scenario 2 and Results



Reservoir Operation Study Computer Program (RESOP) - Example - Continued

- Scenario 3 and Results



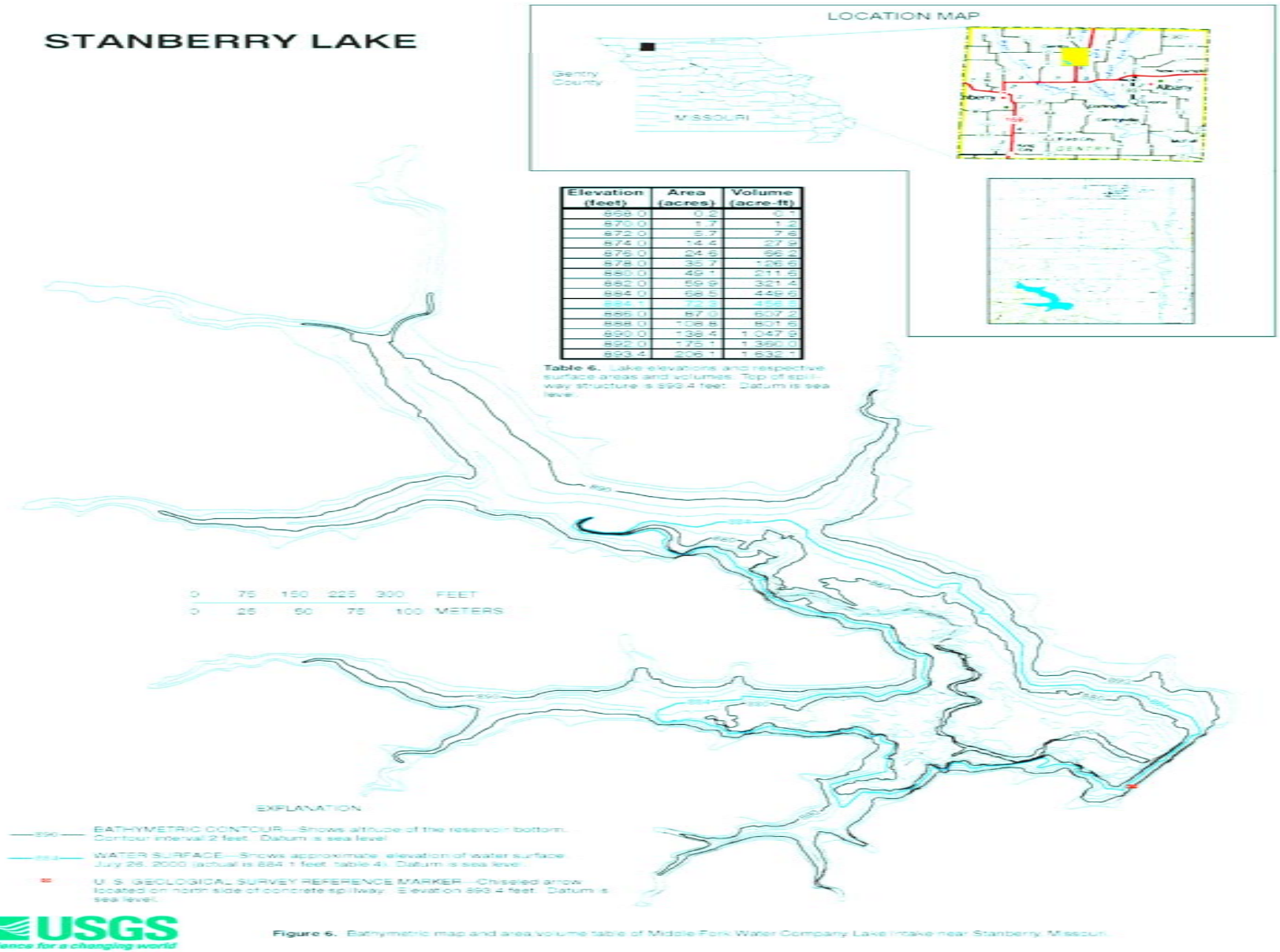
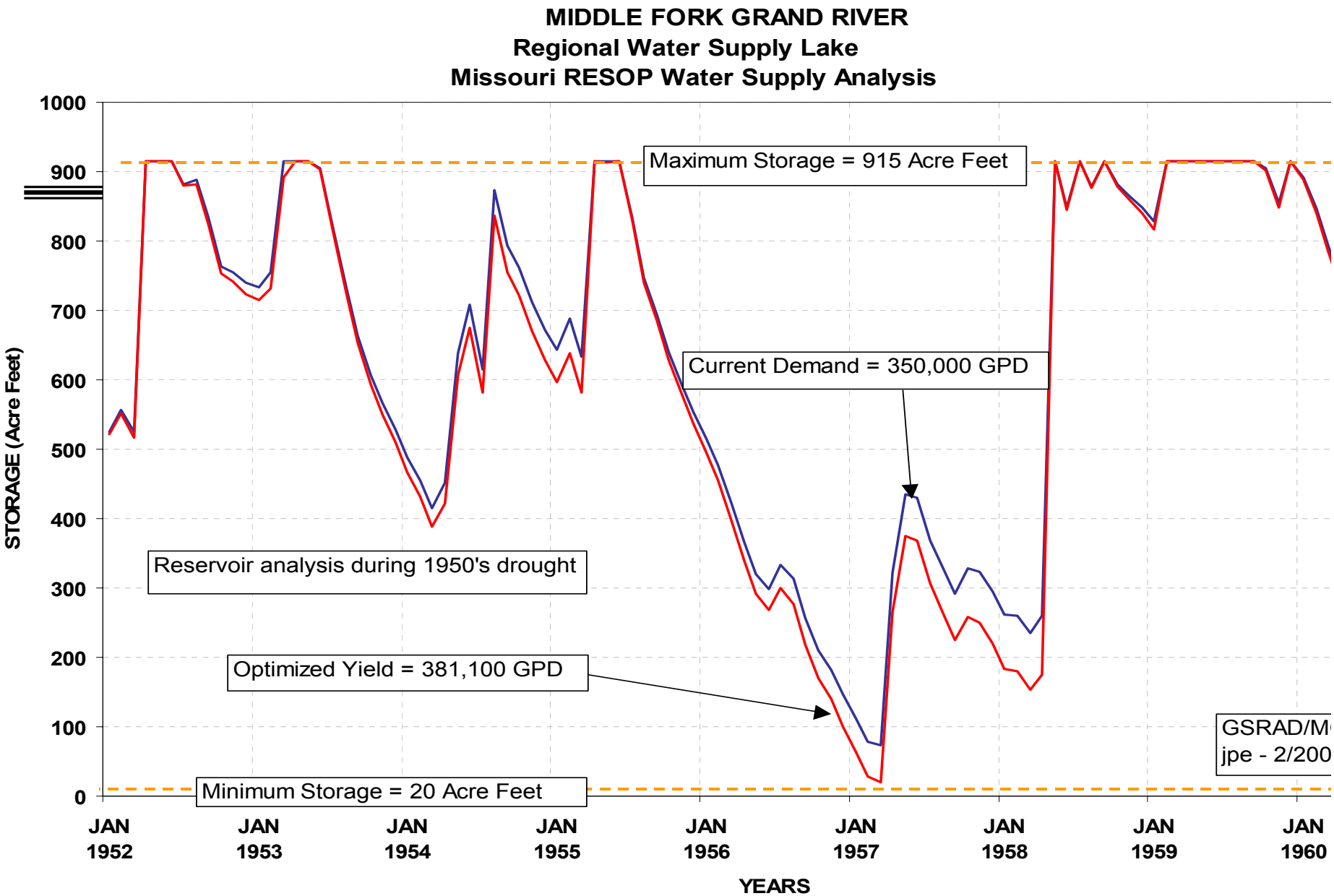


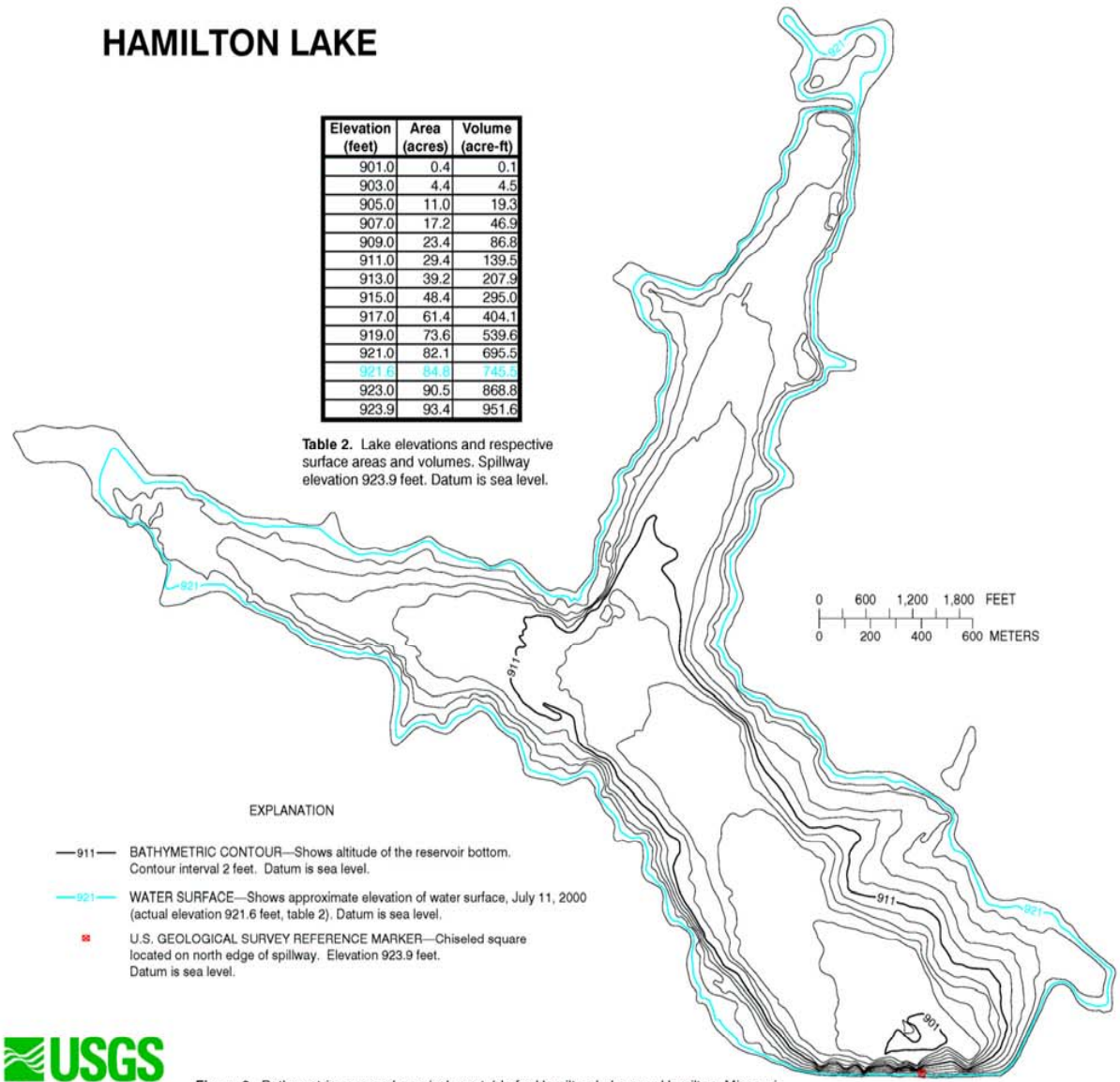
Figure 6. Bathymetric map and area/volume table of Middle Fork Water Company Lake intake near Stanberry, Missouri.


MIDDLE FORK GRAND RIVER
Regional Water Supply Lake
Missouri RESOP Water Supply Analysis
STORAGE (Acre Feet)
1000
900
800
700
600
500
400
300
200
100
0
Maximum Storage = 915 Acre Feet
Current Demand = 350,000 GPD
Reservoir analysis during 1950's drought
Optimized Yield = 381,100 GPD
Minimum Storage = 20 Acre Feet
GSRAD/M
jpe - 2/200
JAN 1952
JAN 1953
JAN 1954
JAN 1955
JAN 1956
JAN 1957
JAN 1958
JAN 1959
JAN 1960
YEARS

HAMILTON LAKE

Elevation (feet)	Area (acres)	Volume (acre-ft)
901.0	0.4	0.1
903.0	4.4	4.5
905.0	11.0	19.3
907.0	17.2	46.9
909.0	23.4	86.8
911.0	29.4	139.5
913.0	39.2	207.9
915.0	48.4	295.0
917.0	61.4	404.1
919.0	73.6	539.6
921.0	82.1	695.5
921.6	84.8	745.5
923.0	90.5	868.8
923.9	93.4	951.6

Table 2. Lake elevations and respective surface areas and volumes. Spillway elevation 923.9 feet. Datum is sea level.



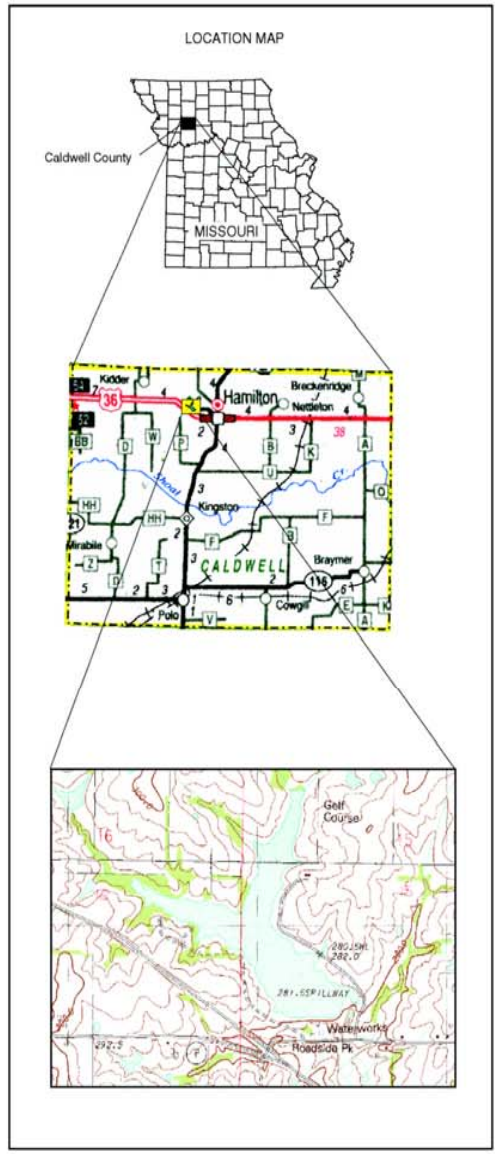


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Figure 2. Bathymetric map and area/volume table for Hamilton Lake near Hamilton, Missouri.

HAMILTON RESERVOIR

RESERVOIR ANALYSIS DURING 1950'S DROUGHT